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# Time-trends in rates of hospital admission of adolescents for violent, self-inflicted or drug/alcohol-related injury in England and Scotland, 2005-2011:population-based analysis

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**Ethics statement:** We received a standard, de-identified data extract from the Health and Social Care Information Centre, which does not require research ethics approval or patient consent (1).

**Data access:** Extracts of Hospital Episode Statistics© inpatient data can be applied for via the UK Health and Social Care Information Centre (www.hscic.gov.uk/dars). Extracts of Scottish Morbidity record data for research purposes can be applied for via the electronic Data Research and Innovation Service (NSS.edris@NHS.net). Population mid-year estimates that were used to derive population denominators are available here: www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-365199.

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**Abbreviations**: CI: Confidence Interval, CIRV: Community Initiative to Reduce Violence, ECM: Every Child Matters, GIRFEC: Getting it Right for Every Child, HES: Hospital Episode Statistics,

ICD-10: International Classification of Diseases 10th revision, SMR: Scottish Morbidity Record, NHS: National Health Service

## ABSTRACT

### Background

Incidence of emergency admissions for violent injury in 10- to 18-year olds decreased in England and Scotland between 2005 and 2011, but more steeply in Scotland. To generate hypotheses about causes of these differences, we determined whether trends were consistent across admissions for three common types of adversity-related injury (violent, self-inflicted and drug/alcohol-related).

### Methods

Emergency admissions to NHS hospitals were captured using Hospital Episode Statistics and Scottish Morbidity Records. Adversity-related injury was defined using ICD-10 codes. Analyses were stratified by sex/age groups (10-12, 13-15 and 16-18 years) and adjusted for background trends in admissions for injury.

### Results

During 2005-2011, rates declined in all sex/age groups in Scotland (reductions adjusted for background trends ranged from -22.0 to -103.7/100 000) and in girls and boys aged <16 years in England (adjusted reductions -12.0 to -49.9/100 000). However, these rates increased in England for both sexes aged 16-18 years (adjusted increases, girls 71.8/100 000; boys 28.0/100 000). However, throughout 2005-11 overall rates remained relatively similar in England and Scotland for both sexes aged <16 years, and remained higher in Scotland for both sexes aged 16-18 years.

### Conclusions

A greater decline in the rates of emergency admissions for adversity-related injury for adolescents in Scotland compared with England could signal more effective policies in Scotland for reducing violence, self-harm, drug/alcohol misuse.

**Key words (MesH terms):** Violence, Self-injurious Behaviour, Drug/alcohol-related Disorders, Adolescent

## BACKGROUND

In England, approximately 1 in 25 adolescents have at least one emergency admission to hospital between 10 and 19 years of age for adversity-related injury (2). By 'adversity', we mean violence, self-harm or drug or alcohol misuse. Adolescents discharged after adversity-related injury have twice the risk of death or emergency re-admission in the subsequent 10 years compared with adolescents discharged after accident-related injury (3). Effective preventive policies to reduce the incidence of admissions for adversity-related injury could improve health and wellbeing of adolescents and young adults, and reduce societal burden and costs due to violence, self-harm and drug and alcohol misuse (4-6). However, prevention strategies need to address a range of risk factors related to socioeconomic disparities, lack of social support, and availability of drugs and alcohol. Preventive interventions may be delivered through societal, judicial and health service responses to violence, drugs and alcohol, and mental health needs (7).

Comparisons between countries in the incidence of hospitalization for adversity-related injury can offer insights into the potential impact of policies and policy context (societal landscape, e.g. cultures, levels of inequalities or unemployment) on the occurrence of adversity and related injury. We previously showed steeper declines in rates of admissions for violent injury in 11- to 18-year olds in Scotland compared with England between 2005 and 2011 (8). These different declines may reflect different policy interventions and organisational approaches for vulnerable children and adolescents. This explanation is supported by evidence from community surveys that weekly alcohol consumption increased for 15 year olds in England between 2005 and 2010 (by 10%points) but declined in Scotland (by 10-11%points) (Supplementary data, Table S1) (9, 10). Another potential explanation could be shifts in recognition, i.e. labelling or coding of admissions for different types of adversity-related injury. These shifts might differ by country and by sex and age (11). Injuries related to violence, self-harm or drug or alcohol misuse often occur for the same individual and reflect

similar psychosocial risk factors (2, 12-15). Hence a shift in favour of labelling violent injury as being related to drug or alcohol misuse, for example, could lead to spurious declines in admissions for violent injury.

In this report, we compared time-trends between England and Scotland, two countries with similar policy contexts (16), in the incidence of emergency admissions for any adversity-related injury between 2005 and 2011, with separate analyses for girls, boys and adolescent age groups. We also compared these trends for each type of adversity-related injury (violent, self-inflicted and drug/alcohol-related). We used administrative data for all admissions for injury to NHS hospitals, in each country. The aim was to inform policymakers about varying trends between countries in order to generate hypotheses about the extent to which any differences might be related to preventive policies.

# METHODS

## Study population

We used Hospital Episode Statistics (HES) for England and Scottish Morbidity Records (SMR01) to identify all emergency admissions for injury to the NHS in adolescents (10- to 18-year olds) between January 2005 and December 2011 (17, 18), and to determine time-trends of these admissions for each country. We chose to study the time period 2005-2011 because it followed the launch of two key government initiatives: Every Child Matters (ECM) in England and Getting it Right for Every Child (GIRFEC) in Scotland.(19, 20) Both initiatives aimed at earlier intervention and better integration of services for vulnerable children. This period also covered the introduction of policies in Scotland to tackle high rates of violence, and drug and alcohol misuse. Key policies are summarized in Box 1.

We received standard, de-identified data extracts of HES from the Health and Social Care Information Centre and SMR01 from the Information Services Division in Scotland, which did not require research ethics approval or patient consent (1). As the two datasets contained the majority of our population of interest, that is, adolescents admitted to hospital as an emergency with injury, we did not carry out a sample size calculation.

## Identifying admissions for adversity-related injury

Methods for identifying emergency admissions for injury have been reported elsewhere (8). In brief, we used the method of admission field to identify emergency admissions ('admimeth' in HES, 'Admission type' in SMR01), and International Classification of Diseases 10$^{th}$ revision (ICD-10) 'S' or 'T' codes (i.e., ICD-10 Chapter XIX) to identify injury. Mutually exclusive clusters of codes indicated whether an injury was related to adversity (violent, self-inflicted or drug/alcohol-related) (2). We counted all admissions within 2 days of a previous discharge as the same admission (including day cases).

Population denominators were derived from national mid-year population estimates by age year and calendar year (21, 22).

## Analyses

All analyses were carried out by sex and age groups (10-12, 13-15 and 16-18 years) to reflect transitional stages in socialisation, e.g. drinking behaviours (23). As thresholds of admission for injury may vary over time, and vary differently between countries, primary analyses determined trends within countries in admissions for any adversity-related injury adjusted for background trends in admissions for injury (i.e. that was not adversity-related). Secondary analyses determined these adjusted trends for each type of adversity-related injury separately (violent, self-inflicted and drug/alcohol-related). Individuals admitted for multiple types of adversity-related injury contributed to each of these separate secondary analyses but only once in primary analyses.

We plotted monthly crude (observed) incidence rates of adversity-related injury (with mid-year population estimates as denominators), and 3-monthly rolling (smoothed) average rates. We also plotted background trends in admissions for injury for each sex and age group in England and Scotland (Supplementary data, Fig S1).

We compared crude absolute differences in yearly incidence between 2005 and 2011 within each country-sex-age combination, with 95% confidence intervals (CIs). As power was limited to test for the interaction between time-trends and country, we fitted separate negative-binomial models, per country (and by sex and age groups), with monthly admissions for adversity-related injury as the dependent variable, time (in month) as the independent variable, and population size as an offset (Supplementary data, Equation S1). We adjusted for trends in other types of injury by including number of admissions for injury that were not

131 adversity-related as another independent variable. We also adjusted for season (January-
132 March, April-June, July-September and October-December). We used the adjusted January
133 2005 rate (model intercept) and adjusted gradient (time coefficient) to estimate adjusted
134 absolute differences in rates between 2005 and 2011.

135 For each multivariable negative-binomial model, we fitted a corresponding Poisson model.
136 For each country-sex-age combination, the negative-binomial model gave a superior fit for
137 the data according to the log-likelihood ratio test and thus we present these results. All
138 calculations, plots and regressions were carried out in R (R V.2.14.2 (http://www.R-project.org).
139 Rates of admissions for adversity-related injury in 2005 and 2011, and observed and adjusted
140 gradients and differences are presented for each type of adversity-related injury in
141 Supplementary data, Tables S1-S3.

# RESULTS

The incidence of emergency admissions for adversity-related injury in England and Scotland across the period 2005-2011 ranged from 48.9/100,000 for 10- to 12-year-old girls to 978.2/100,000 for 16 to 18-year-old boys, with the highest rates in Scotland (Table 1). Admissions for adversity-related injury accounted for 4.3-65.7% of all admissions for injury between different sex-age groups. Drug/alcohol-related injury was the most prevalent type of adversity-related injury, particularly among 16- to 18-year-old girls, and was recorded in 46.3-92.4% of admissions for adversity-related injury.

## Trends in admissions for injury from 2005-2011

Supplementary data, Fig. S1 shows that background rates in admissions for injury that was not adversity-related had a strong seasonal pattern, with higher rates in summer. In all age groups in both countries, rates of injury that was not adversity-related remained stable in girls and declined in boys, but were always higher in Scotland than in England. Trends in admissions for adversity-related injury had a similar seasonal pattern to those for injury that was not adversity-related (Fig. 1). Unadjusted rates of admissions for adversity-related injury declined in all age groups in both sexes and in both countries, apart from an increase in 16- to 18-year-old girls in England (Fig. 1, Table 2). Supplementary data, Figs S2-S4 show observed and smoothed monthly trends separately for violent, self-inflicted and drug/alcohol-related injury.

Analyses of incidence trends in admissions for adversity-related injury, adjusted for background trends in injury not related to adversity, showed decreasing rates for all groups in Scotland and in England for those younger than 16 years (Table 2). However, in England rates increased for girls and boys aged 16-18 years. The annual increase in adjusted incidence for 16- to 18-year-old girls was 2.46/100 000/year (95% CI: 1.24, 3.70) but was much smaller

for 16- to 18-year-old boys (0.25/100 000/year; 0.09, 0.41). Estimated absolute differences in adjusted rates of admissions for adversity-related injury revealed significant reductions between 2005 and 2011 (at the 5% level) for girls and boys younger than 16 years in England and all sex and age groups in Scotland, and significant increases for 16- to 18-year olds of both sexes in England (Table 2).

Adjusted analyses of admissions, by each type of adversity-related injury separately, showed varied incidence trends for girls and boys in England (Fig. 2; Supplementary data, Tables S2-S4). For girls in England, adjusted rates of admissions for violent injury increased across all age groups. Rates decreased for self-inflicted injury in girls aged younger than 13 years and for drug/alcohol-related injury in girls aged younger than 16 years. For boys in England, adjusted rates of admissions for violent injury decreased in all age groups, but rates for self-inflicted and drug/alcohol-related injury increased in 16- to 18-year olds. In Scotland, there were consistent declines across all types of adversity-related injury for both sexes in all age groups.

# DISCUSSION

## Main finding of the study

Rates of admission for any adversity-related injury, adjusted for background rates in admissions for other types of injury, declined for adolescents younger than 16 years in England and Scotland, with the largest reductions in Scotland. Trends were opposing between countries for 16- to 18-year olds, increasing in England and declining in Scotland.

In England, trends varied by the type of adversity-related injury: rates of admissions for violent injury increased in girls, but those for self-inflicted and drug/alcohol-related injury decreased. In boys, rates of admissions for violent injury decreased but those for self-inflicted and drug/alcohol-related injury increased. In Scotland, incidence rates declined for all types of adversity-related injury in both sexes and in all age groups.

### What is already known on this topic

We previously reported trends in admissions to hospitals in England and Scotland for injury sustained through maltreatment or violence, in children of all ages (8). We reported decreasing rates of admissions for violent injury between 2005 and 2011 for adolescents aged 11-18 years in England, with a steeper decline in Scotland. Community surveys of alcohol use in 15-year olds in England and Scotland have indicated diverging rates of weekly alcohol consumption with a 10%point increase in England between 2005 and 2010, coinciding with a decrease of 10-11% points in Scotland (Supplementary data, Table S1) (9, 10).

### What this study adds

This is the first study to report trends in admissions of adolescents for all three types of adversity-related injury, within the same sample. Our study confirms that declining trends in admissions for *any* adversity-related injury were steeper in Scotland than in England, and that these trends actually increased for older adolescents in England. These findings strengthen

the argument that the previously reported steeper declines in admissions of 11-18 year olds for violent injury in Scotland when compared with England were not driven by coding shift (8), i.e. a trend in labelling admissions for violent injury as admissions for other types of adversity-related injury instead.

Although policy contexts were similar in England and Scotland (16), our study raises questions about whether preventive policies in Scotland, for example, those described in Box 1, were more effective than in England at reducing the incidence of adversity-related injury among 16-18 year olds. Most importantly, our findings suggest that rates of admissions to hospital for adversity-related injury can be reduced, over and above background trends in admissions for other types of injury.

## Limitations of this study

England and Scotland operate similar systems of universal access to healthcare, free at the point of use, and have similar emergency and primary care services. As thresholds for injury admission may vary over time and between countries, we estimated adjusted trends and absolute risk differences, taking into account rates in admissions for injury not related to adversity. However, we cannot rule out the possibility of changes in admission thresholds specifically for adversity-related injury, contributing to the differences over time and between countries. We cannot estimate the magnitude of these thresholds without linked data from other health services, e.g. accident and emergency. Such analyses may be possible as recording of adversity and linkage between administrative datasets improve (24-26).

In Scotland, rates declined across all types of adversity-related injury, but in England trends in rates of admissions within sex and age groups were inconsistent between different types of adversity-related injury, particularly in the oldest age group. The variation in England may

reflect true differences in trends of admissions for different types of adversity-related injury. However, these opposing trends may also reflect coding shifts over time. Although the monthly trends do not suggest any sudden changes that might reflect adoption of different coding practices, we cannot rule out a gradual shift in the use of codes between violent, drug/alcohol-related or both types of adversity-related injury. Further research is needed to examine regional variations in trends, and how changes related to socioeconomic status (27).

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